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A STUDY ON TECHNOLOGICAL PARAMETERS IN CROP-WISE AGRICULTURAL PRODUCTION FUNCTION IN NELLORE DISTRICT: ANDHRA PRADESH

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ABSTRACT

A production function provides information concerning the quantity of output that may be expected when particular inputs are combined in a specific manner. The chemical, physical and biological properties determine the kind and amount of output which will be received from particular combination of inputs. Crop production by and large can be increased by increasing area under cultivation, double cropping and rising the yields of crops per hectare by the application of new agricultural technology and by the recognisation of institutional factors. The study aims to analyse the Crop-wise Agricultural Production Function for staple crops-paddy and groundnut and Resource use efficiency based on entire sample of Farms in Three Revenue Mandals of Nellore District, Andhra Pradesh. Data was collected for the explanatory and explained variables with the help of survey method through personal interviews of the farmers selected through mixed sampling in three revenue mandals of Nellore district. Regression co-efficients are estimated to study the relationship between gross output and various factors of production. By studying the Marginal Value Products of factors of production, we assessed the relative importance of factors of production. The sum of the elasticities and their statistical significance was also studied.

KEYWORDS: Crop-Wise Agricultural Production Function, Ordinary Least Squares Method, Regression Co - Efficients, Marginal Value Product, Marginal Cost, Paddy, Groundnut

INTRODUCTION

Production is a process, where by some goods and services called inputs are transformed into other goods and services called outputs. Many types of activities are involved in the production including changes in farms, location and the time of use of products. Each of these changes involves the use of inputs to produce the desired outputs. The farms outputs of products depends upon the quantities of inputs used in production. This relation between input and output can be characterized by a production function. A production function provides information concerning the quantity of output that may be expected when particular inputs are combined in a specific manner. The chemical, physical and biological properties determine the kind and amount of output which will be received from particular combination of inputs.

Crop production by and large can be increased by increasing area under cultivation, double cropping and raising the yields of crops per hectare by the application of new agricultural technology and by the recognisation of institutional factors. Crop-wise disaggregation becomes important because not merely can be used but the effect of a mechanized technique vary between operations in the cultivation of a given crop, but it can also vary from crop to crop and region to region. Some crops lend themselves earlier to mechanization than other, for these mechanized techniques are more readily adopted. Hence, we note for instance, that the use of tractors in paddy cultivation in Punjab is largely confined to villages, while in wheat it extends to several other operations as well. Also even if the same mechanized technique was used for the same operation, its output and employment effects could vary among groups. Hence two farmers using the same

mechanized techniques (new agricultural technology) and having different cropping patterns could have different uses for it and the overall farm output and employment effects would likewise differ.

There are number of studies on the agricultural sector in Nellore district. Among these studies, the research on agricultural production is very limited. The empirical investigations are needed to study the crop-wise agricultural production function. Hence, the empirical and scientific investigational study of crop-wise agricultural production function in the rural economy of Nellore district is an important phenomena. In the present study, an attempt has been made to study the crop-wise production function for staple crops-paddy and groundnut basing on entire sample of farms of three mandals, namely, Kaligiri, Muttukur and Pellakur of Nellore district of Andhra Pradesh.

REVIEW OF LITERATURE

Pandy and Shanti Sarup [1] discussed the level of output and input use as well as estimation of productivity equation of rice. The analysis also examined the variation in the level of resource use efficiency in different states in India. The analysis leads to the conclusion that the selected inputs used in rice production have affected the level of yields in various states in different ways. It is found that the estimated production functions highlighted the significant role of fertilizers in most of the states during the pre-green revolution period as well as post-green revolution period. The study indicated that spread of improved rice technology, though not uniform in different states and it has led to increased rice productivity in the country. The study further indicated that the elasticity of rice productivity with respect of fertilizer use was relatively higher during the period from 1966-67 to 1979-80. Yadav and Gangwar[2] studied the economics of technological change in rice production. An attempt has been made to determine empirically the parameters of change from old to new rice technology in Dharbhanga district of Bihar state. Cobb-Douglas Production Function was fitted to measure the efficiency of different inputs used in production techniques of local and HYV rice. It was observed that the technological change has increase the per hectare net return of HYV rice by 786 percent more than that of the local one. Positive correlation has been found between net return and holding size-group. The results also point out that except land and drought-power all other inputs like human-labour, nitrogen, phosphorus and other inputs costs which include plant protection measures also have higher elasticity of production in the case of HYV rice as compared to the local. It shows the higher responsiveness of HYV rice to the component of new technology as compared to the local.

Adinarayana [3] studied the comparative economics of high-yielding and local varieties of kharif rice in coastal Andhra Pradesh. It is observed that the cost of cultivation of HYV rice was higher than the local variety. The costs were proportionate with farm size in the case of HYV farms, while on consistent trend was observed among local variety farms. The cost of returns were relatively more among HYV farms. He concluded that the adoption of HYV technology helps in increasing the farm income through increased productivity, creation of additional employment opportunities and to maintain egalitarian order in rural parts. Mythili and Shanmugam [4] study estimates the technical inefficiency of individual rice farmers in Tamil Nadu. This study uses the stochastic frontier production approach. They find that the technical factors varies widely (Ranging from 46.5 percent to 96.7 percent) across sample farms and is time invariant. The mean technical efficiency is computed as 82 percent, which indicates that on an average, the realized output can be increased by 18 percent without any additional resources.

Eswara Prasad, Srirama Murthy, Satyanarayana, Chennarayudu and Lalith Achoth [5] studied the extent of resource use efficiency of various resources in cotton farms in Guntur district. The allocative efficiency was studied by deriving the marginal value products of resources from the Cobb-Douglas Production Function and comparing it with opportunity or acquisition costs. The results of the production function and analysis clearly indicated the need for resources

adjustments in farms of both LPS-141 (recent variety) and MCU-5 (traditional variety), in order to raise the productivity levels. The authors observed that no input in the production process was being used in optimum level. The result is regarding the strong direct effect on production in MCU-5 has much practical significance in the light of the production function being in the increasing returns to scale and the fact that labour is under-used. Gajja, Sharma and Joshi[6] used Cobb-Douglas Production Function to estimate the magnitude of influence of various factors on the productivity of the selected crops. The specific objectives of this paper are to examine (i) The variation in land productivity in terms of production per unit area under different irrigation classes and (ii) the influence of land irritability class, fertilizers, human labour and other expenses on this variation. The results of the study showed that the crop productivity was found to be negatively associated with land irritability class and soil degradation levels. The land irritability class and soil degradation have negative effect on crop productivity. The co-efficient of fertilizer, family labour and hired labour, were significantly negative in all the equations.

Sankhayan and Sirohi[7] made an attempt to measure the productivity of various agricultural resources on the seed potato and maize farms and examine possibilities of increasing returns by reallocation of the existing resources within seed potato and maize crop. The results suggested that at the present level of technology the farm resources within each crop are optimally or nearly optimally allocated. There seems, therefore, no possibility of increasing the farm returns through the reallocation of the limited available capital among various inputs uses in seed potato. In the case of maize crop, however, there appeared a possibility to increasing return by diverting funds for human-labour to manures and fertilizers, because the marginal value product of the farmer was significantly lower than the latter.

OBJECTIVES OF STUDY

The following are the objectives of the study:

- To study the Crop-wise Agricultural Production Function for staple crops-paddy and groundnut based on entire sample of Farms in Three Revenue Mandals of Nellore District, Andhra Pradesh.
- To study the Agricultural Resource use efficiency in Three Revenue Mandals of Nellore District, Andhra Pradesh.

DATA COLLECTION

The following methodology is adopted to study the above objectives. The present study extends over Nellore district of Andhra Pradesh. A multistage random sampling design was used. We purposefully selected three mandals, Namely Kaligiri, Muttukur and Pellakur of Nellore District at the first stage and later with help of random sampling ten to twelve villages were selected from each Mandal.

After the selection of villages a complete list of agricultural families was prepared. Data was collected for the explanatory and explained variables with the help of survey method through personal interviews of the farmers selected through mixed sampling for this study relating to the agricultural year 2004-2005.

Specification of Variables

A great deal of caution is essential in the selection, classification and aggregation of input variables used in the production process for studying resources productivity. Different researchers have classified and aggregated farm inputs in different ways suitable for their studies. Various ways of classifying and aggregating input variables in production function studies together with a brief description of variables used as explanatory variables in the present study are giving below.

Bullock - Labour

Preparation of farm is an important agricultural work and bullock-power have been taken as an explanatory variable by a number of writers. Chaudhari[8], Reddy and Sen[9], Hopper[10] and Radhakrishna[11] have used it in terms of plough unit days consisting of one pair of animal-labour day and one human-labour day comprising one plough unit. While Rajkrishna[12], Badal and Singh[13] specified this variable in terms of bullock-labour days, Robellow and Desai[14] included a labour with a pair of bullocks. Here, we also include one human-labour to a pair of bullocks and specify them in value terms. This done with the help of accounting prices

Human - Labour

Human-labour too, has been used as an explanatory variable in the estimation of production functions either in physical units of time or in value of terms. Shan [15] and Goyal [16] used all human labour while, Hopper [10] and Mathur [17] used all human-labour except those associated with plough unit in value terms. Sharma and Sharma [18], Hanumantha Rao[19], Rajkrishna [12], Singh[20] and Eswara Prasad[5] have used all human-labour in terms of man-days. We also include human-labour as an explanatory variable but from it exclude those labourers who are engaged in traditional irrigation work and are associated with bullock units. Variable is specified in terms of rupees.

Seeds

A few writers have used seeds as explanatory variable in their functions. Prasad[21], Debnarayan Sarker and Sudptia De[22] used seeds as a separate explanatory variable in his study terms of expenditure on seeds. We also include seeds in our functions, the prices of seeds are determined at the prevailing market price of the seeds at the seeding time.

Irrigation

Assured and effective irrigation which has been one of the most important factors in the production function studies. Rajkrishna [12], Timothy and Krishna Moorthy [23] has specified this variable in terms of expenses on irrigation. We also specify it in the same term. Expenses on irrigation include permanent of wages to labourers used in traditional system of irrigation, water charges paid to the Government for the use of state tube-wells, hire-price of the water received from private tube-wells and pumping sets. Expenses also include accounting prices for the water received from farmers own pumping sets and tube-wells.

Fertilizer

Fertilizer is one of the most important components in Agricultural Production. Parikh [24] and Shan [15] Mythili and Shanmugam [4] has used chemical fertilizers as separate variable, while Basak and Choudhary[25] have included manure along with chemical fertilizers as an explanatory variable. Yadav and Gangwar [2] considered various categories of chemical fertilizers as independent explanatory variables. In the present study, though category-wise chemical fertilizer is not taken, chemical fertilizers and pesticides and natural fertilizers are specified as separate variables, and taken in value terms. While expenses on chemical fertilizer are the actual expenses, help of accounting price has been taken to determine the expenses on traditional fertilizers, like seen manure, compost burnt of waste goods and cow-dewing.

Plant Protection

Plant protection measures are included as explanatory variable. Prasad[21] and Badal and Singh[13] taken them in terms of expenditure on their use. In our study also this variable is specified in terms of actual expenditure. Like specification of variables, specification of an equation showing functional relationship between inputs and output is an

important aspect of production function studies. Many of the economists used the generalized Cobb-Douglas Production Function to study the relation between the inputs and output in production analysis. The following production function has been specified for crop-wise analysis.

METHODOLOGY

Crop-Wise Enterprise

To study the crop-wise production function based on entire sample of farms, the following production function was fitted for some important crops namely Paddy and Groundnut.

$$Y_i = a_{i0} X_{i1}^{a_{i1}} X_{i2}^{a_{i2}} X_{i3}^{a_{i3}} X_{i4}^{a_{i4}} X_{i5}^{a_{i5}} X_{i6}^{a_{i6}} X_{i7}^{a_{i7}} \quad (1)$$

Where,

i = P and G represents Paddy and groundnut

Y = Gross output including by-products (in Rs.)

a_0 = Intercept

X_1 = Bullock Labour (in Rs.)

X_2 = Expenditure on Tractor (in Rs.)

X_3 = Human Labour (in Rs.)

X_4 = HYV Seeds (in Rs.)

X_5 = Chemical Fertilizers (in Rs.)

X_6 = Manures (in Rs.)

X_7 = Pesticides and other Plant Protection Expenditure (in Rs.)

and a_1, a_2, a_3, a_4, a_5, a_6 and a_7 are the elasticities.

Marginal Value Products

By studying the Marginal Value Products of factors of production, we can assess by their relative importance of factors of production. Marginal Value Product of X_i, the i^{th} input is estimated by the following formula:

$$MVP\ (X_i) = \alpha_i \frac{G.M.(Y)}{G.M.(X_i)} \quad (2)$$

Where,

G. M. (Y_i) and G.M. (X_i) represent the geometric means of output and input respectively, α_i is the regression Co-efficient of i^{th} input.

FINDINGS

Crop-Wise Production Analysis

To study the crop-wise production function based on entire sample of farms, we considered the production function

$$Y_i = a_{i0} X_{i1}^{a_{i1}} X_{i2}^{a_{i2}} X_{i3}^{a_{i3}} X_{i4}^{a_{i4}} X_{i5}^{a_{i5}} X_{i6}^{a_{i6}} X_{i7}^{a_{i7}} \quad (3)$$

The equation is estimated by the method of ordinary least squares and the estimated parameters with the other related statistics are presented in the table 1. By using the Klein[26] and Heady-Dillon[27] test of multi co-llinearity was carried out to examine the presence of multi co-llinearity and results were indicate the absence of multi co-llinearity between the variables.

Table 1: Estimated Parameters and Other Related Statistics of the Function Related to Different Crops

Inputs	Description of Inputs	Kaligiri		Muttukur		Pellakur	
		Paddy	Groundnut	Paddy	Groundnut	Paddy	Groundnut
a_0	Intercept	2.6198	2.9299	1.6306	2.8006	2.6372	3.0024
X_1	Bullock-labour	-0.0014 (0.0013)	0.0019 (0.0038)	0.0042 (0.0171)	0.3589* (0.0550)	-0.0070* (0.0024)	0.0180 (0.0155)
X_2	Expenditure on Tractor	0.0010 (0.0021)	0.0001 (0.0020)	-0.0169 (0.1976)	0.0276* (0.0080)	-0.0080 (0.0085)	0.0061 (0.0047)
X_3	Human-labour	0.4161* (0.0489)	0.1610* (0.0619)	0.8175* (0.2122)	0.1782* (0.0403)	0.1041* (0.0302)	0.0153 (0.0718)
X_4	HYV Seeds	0.1562* (0.0319)	0.1878 (0.0514)	0.0208 (0.1270)	0.1221* (0.0466)	0.2951* (0.0473)	0.0079 (0.0621)
X_5	Chemical Fertilizers	0.0950 (0.0552)	0.1412* (0.0656)	-0.0247 (0.1162)	0.1898* (0.0697)	0.4850* (0.0567)	0.5905* (0.1271)
X_6	Manures	0.0367 (0.0337)	0.1426* (0.0454)	-0.0323 (0.0807)	0.0915 (0.0691)	0.1033* (0.0523)	0.2799 (0.1047)
X_7	Pesticide and other Plant Protection Expenditure	0.3057* (0.0380)	0.3308 (0.0757)	0.3270* (0.1296)	0.0760 (0.0408)	0.0648* (0.0327)	0.0826 (0.0680)
-	R^2	0.98971	0.93635	0.95063	0.98287	0.98812	0.95188
-	F	1676.223*	256.337*	636.1134*	1082.017*	1687.255*	401.2753*
	SUM	1.0093	0.9654	1.0956	1.0441	1.0373	1.0003

*Significant at 5% Probability level.

Figures in the Parentheses are Standard Errors.

From the table 1 the value of R^2 reveals the collective effect of all variables on output. F-test was carried out to test the significance of R^2 and it was found significant at 5 percent probability level for all crops in three mandals under study. The included variables explained about 99 percent and 94 percent of variation in outputs of paddy and groundnut in Kaligiri mandal. The explanatory variables collectively explained 95 percent of variation in output of paddy paddy and 98 percent in groundnut output in Muttukur mandal. In the case of Pellakur mandal, all independent variables explained 99 percent of variation in paddy output and 95 percent in groundnut output. The estimated equation shows true relationship between output and inputs. The fitted equations are good fits.

Kaligiri Mandal - Paddy

From the table 1, it is observed that the regression co-efficient of bullock-labour is negative and it is -0.0014. Keeping all other variables are constant at their respective geometric mean level, with the increase of one rupee in bullock labour, the amount of gross output of paddy would tend to decline by Rs. 0.001. A negligible negative effect was observed by Bullock-labour. The regression co-efficients of human-labour, HYV seeds, chemical fertilizers, manures and other plant protection methods are positive and they are 0.4161, 0.1562, 0.0950, 0.0367 and 0.3057 respectively. The regression co-efficients of human-labour, HYV seeds and pesticides and other plant protection methods are statistically significant at 5 percent probability level. Keeping all other variables constant at their respective geometric mean level, with the increase of

one rupee in human-labour, the amount of gross output of paddy would tend to increase by Rs. 0.42. Similarly, an increase of one rupee in each of the variables HYV seeds, chemical fertilizers, manures and pesticides and other plant protection expenditure will raise the Paddy output by Rs. 0.16, Rs. 0.10, Rs. 0.04 and Rs. 0.31 respectively. The co-efficients of human-labour, HYV seeds, pesticides and other plant protection methods are significant. The effect of these variables on paddy output is significant at 5 percent probability level. A close look at the table revealed the fact that farmers cultivating paddy are using adequate modern technology in agriculture.

Kaligiri Mandal - Groundnut

In the case of groundnut crop, the estimated regression co-efficients of bullock-labour, expenditure on tractor, human-labour, HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods are positive and they are 0.0019, 0.0001, 0.1610, 0.1878, 0.1412, 0.1426 and 0.3308 respectively. The co-efficients of human-labour, chemical fertilizers and manures are statistically significant at 5 percent probability level. Keeping all other variables constant at their respective geometric mean level, an increase of one rupee in human-labour, the amount of groundnut output in Kaligiri mandal would tend to increase by Rs. 0.16. In the same way an increase of one rupee in HYV seeds, the amount of groundnut output in Kaligiri mandal would tend to increase by Rs. 0.41. Similarly, in the case of chemical fertilizers, manures and pesticides and other plant protection methods it would be Rs. 0.14, Rs. 0.14 and Rs. 0.33 respectively. Only the chemical fertilizers, under new technology, will be affecting the groundnut output significantly. Hence the farmers are cultivating groundnut by using modern agricultural technology and thereby getting more yield in Kaligiri.

Muttukur Mandal - Paddy

From table 1, it is noticed that the regression co-efficients of expenditure on tractor, chemical fertilizers and manures are negative and insignificant and they are -0.169, -0.0247, and -0.0323 respectively. Every one unit increase in these variables will decrease the paddy output by 0.17, 0.02 and 0.03 units. But this decrease is not significant. The regression co-efficients of bullock-labour, human-labour, HYV seeds and pesticides and other plant protection methods are positive and they are 0.0042, 0.8175, 0.0208 and 0.3270 respectively. The regression co-efficients of human-labour and pesticides and other plant protection methods are statistically significant at 5 percent probability level. Keeping all other variables are constant at their respective geometric mean level, with the increase of one rupee in expenditure on tractor, the amount of gross output including by-products of paddy in Muttukur mandal would tend to decline by Rs. 0.02. A unit increase in Bullock-labour would tend to increase the paddy output by 0.004 units. But this increase is not significant increase. Similarly, in the case of human-labour, HYV seeds and pesticides and other plant protection methods it would be Rs. 0.82, Rs. 0.02 and Rs. 0.33 respectively. The increase in paddy output by human-labour and pesticides and other plant protection methods was a significant increase. Further, one can say that farmers who are cultivating paddy are over utilizing chemical fertilizers and manures. Hence, in Muttukur mandal, paddy cultivation is not influenced by new technology.

Muttukur Mandal - Groundnut

It is observed that the regression co-efficients of bullock-labour, expenditure on tractor, human-labour HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods are positive and they are 0.3589, 0.0276, 0.1782, 0.1221, 0.1898, 0.0915 and 0.0760 respectively. The co-efficients of bullock-labour, expenditure on tractor, human-labour, HYV seeds and chemical fertilizers are statistically significant at 5 percent probability level. Keeping all other variables are constant at their respective geometric mean level, an increase of one rupee in bullock-

labour, the amount of groundnut output in Muttukur mandal would tend to increase by Rs. 0.36. Similarly, an increase of one rupe in expenditure on tractor, human-labour, HYV seeds, chemical fertilizers, manures, pesticides and other pant protection methods would tend increase by Rs. 0.03, Rs. 0.18, Rs. 0.12, Rs. 0.19, Rs. 0.09 and Rs. 0.08 respectively. The increase in groundnut production by the first five variables is significant. Hence, it may be inferred that the groundnut output in Muttukur was affected by new technology. A close look at the table revealed the fact that the farmers cultivating groundnut are using adequate modern technology in agriculture.

Pellakur Mandal - Paddy

The regression co-efficients of bullock-labour and expenditure on tractor are negative and they are -0.0070 and -0.0080. Keeping all other variables are constant at their respective geometric mean level, with the increase of one rupee in bullock-labour and expenditure on tractor, the amount of gross output including by-products of paddy in Pellakur mandal would tend to decline by Rs. 0.007 and Rs. 0.008 respectively. The estimated regression co-efficient of bullock-labour is significant. The regression co-efficients of human-labour, HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods are positive and significant, they are 0.1041, 0.2951, 0.4850, 0.1033 and 0.0648 respectively. Keeping all other variables are constant at their respective geometric mean level, with the increase of one rupee in human-labour, the amount of gross output of paddy in Pellakur mandal would tend to increase by Rs. 0.10. In the same way, with the increase of one rupee in HYV seeds, the amount of gross output of paddy in Pellakur mandal would tend to increase by Rs. 0.30. Similarly in the case of chemical fertilizers, manures and pesticides and other plant protection methods, it would be Rs. 0.49, Rs. 0.10 and Rs. 0.07 respectively. Except the variable tractor expenditure, the remaining all technological variables, HYV seeds, chemical fertilizers and pesticides and other plant protection methods are shown a significant effect on paddy production. Hence, it reveals that the paddy growers are adopting an adequate modern agricultural technology in Pellakur mandal.

Pellakur Mandal - Groundnut

From table 1, it is noticed that the regression co-efficients of seven selected variables are positive and are 0.0180, 0.0061, 0.0153, 0.0079, 0.5905, 0.2799 and 0.0826 respectively. A positive relationship between the variables each – bullocks – labour, expenditure on tractor, human-labour, HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods and groundnut output was observed. Every one unit increase in each of these variables will increase the groundnut production by 0.02, 0.01, 0.02, 0.01, 0.06, 0.28 and 0.08 units respectively. But a significant increase in output was noticed by chemical fertilizers variable only. It reveals that the crop output was significantly affected by the variable fertilizers i.e., comparatively this technological effect on production was been observed. A close look at the table revealed the fact that the farmers cultivating paddy are using adequate modern technology in agriculture.

In view of the above facts, farmers cultivating paddy and groundnut of Muttukur and Pellakur mandals are utilizing modern agricultural technology whereas farmers cultivating only paddy of Kaligiri mandal are using modern agricultural technology. A study of Yadav and Gangwar[2] expresses the higher responsiveness of HYV rice to the component of new technology as compare to the local. Parikh Ashok[24] found that the area under crop, extent of irrigation and rain fall explained to a great extent of variation in production.

Returns to Scale

The sum of the value of the regression co-efficients or the elasticities of output with respect to different factors for different crops are given in table 2

To test whether there were constant returns to scale or not, t-test was applied to test the significance of the difference;

$$\sum_{i=1}^{7} a_i - 1 \tag{3}$$

Table 2

Crops	Sum of the Co - Efficients		
	Kaligiri	Muttukur	Pellakur
Paddy	1.0093	1.0956	1.0373
Groundnut	0.9654	1.0441	1.0003

In the case of Kaligiri mandal, a close look at the table 2 reveals the fact that the farms are operating at constant returns to scale in the case of paddy and groundnut. In the case of Muttukur and Pellakur mandals also the farms are operating at constant returns to scale in the case of paddy and groundnut.

Resource Use Efficiency

Economic adjustment of resources was examined with the help of ratios of Marginal Value Product (MVP) of inputs and their Marginal Cost (MC). The calculated ratios of MVP and MC are given in table 3, 4 and 5.

Kaligiri Mandal

The calculated ratios of MVP and MC pertaining to Kaligiri mandal are given in table 3.

Table 3: Marginal Value Products of Kaligiri Mandal

Inputs	Paddy			Groundnut		
	MVP	MC	Ratio	MVP	MC	Ratio
Bullock-labour	-0.05880	1.000	-0.05880	0.07064	1.000	0.07064
Expenditure on Tractor	0.03174	1.000	0.03174	0.04733	1.000	0.04733
Human-labour	7.15096	1.000	7.15096	2.77209	1.000	2.77209
HYV Seeds	5.31192	1.000	5.31192	3.85169	1.000	3.85169
Chemical Fertilizers	1.88414	1.000	1.88414	3.31123	1.000	3.31123
Manures	0.06915	1.000	0.06915	3.10498	1.000	3.10498
Pesticide and other Plant Protection Expenditure	8.73917	1.000	8.73917	10.31367	1.000	10.31367

Paddy

From table 3, it is observed that the ratios of MVP and MC of the variables human-labour, HYV seeds, chemical fertilizers and pesticides and other plant protection methods are greater than unity. It indicates the under utilization of these input variables in the production process.

The ratios of bullock-labour, expenditure on tractor and manures are less than unity and this indicates over utilization of bullock-labour, expenditure on tractor and manures. Further, we observed that while expenditure on tractor and manures were marginally under utilized. The use of human-labour, HYV seeds and pesticides and other plant protection methods are deficient. Hence the pattern of resource use in Kaligiri mandal for paddy crop needs some modification, particularly, the application of expenditure on tractor, human-labour, HYV seeds, chemical fertilizers and pesticides and other plant protection methods may be increased and bullock-labour, expenditure on tractor and manures may be reduced.

Groundnut

In case of groundnut crop, the ratios of MVP and MC of human-labour, HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods are greater than unity and this indicates under utilization of these input variables. The ratio of MVP and MC of bullock-labour and expenditure on tractor are less than unity and this indicates over utilization of bullock-labour and expenditure on tractor. Further, it is noticed that while bullock-labour and expenditure on tractor are marginally utilized, the use of human-labour, HYV seeds, chemical fertilizer manures and pesticides and other plant protection methods are not sufficiently utilized. Therefore, the pattern of resource use in Kaligiri mandal needs some modification for groundnut, particularly, the application of human-labour, HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods may be increased whereas bullock-labour and expenditure on tractor may be reduced.

Muttukur Mandal

The calculated ratios of MVP and MC pertaining to Muttukur mandal are given in table 4.

Table 4: Marginal Value Products of Muttukur Mandal

Inputs	Paddy			Groundnut		
	MVP	MC	Ratio	MVP	MC	Ratio
Bullock-labour	1.65991	1.000	1.65991	17.34961	1.000	17.34961
Expenditure on Tractor	-0.32012	1.000	-0.32012	0.72615	1.000	0.72615
Human-labour	13.45206	1.000	13.45206	3.09589	1.000	3.09589
HYV Seeds	0.66680	1.000	0.66680	2.21349	1.000	2.21349
Chemical Fertilizers	-0.47115	1.000	-0.47115	4.00636	1.000	4.00636
Manures	-0.67220	1.000	-0.67220	1.89322	1.000	1.89322
Pesticide and other Plant Protection Expenditure	8.83245	1.000	8.83245	2.13699	1.000	2.13699

Paddy

The table 4, reveals that the ratios of MVP and MC of bullock-labour, human-labour, and pesticides and other plant protection methods are greater than unity. It indicates the under utilization of these input variables. The ratios of the variables expenditure on tractor, HYV seeds, chemical fertilizers and manures are less than unity and expresses the over utilization of the variables expenditure on tractor, HYV seeds, chemical fertilizers and manures. It also observed that while HYV seeds was marginally utilized, the use of bullock-labour, human-labour and pesticides and other plant protection methods are deficient. Hence the pattern of resource use in Muttukur mandal needs some modification, particularly, the application of bullock-labour, human-labour and pesticides and other plant protection methods may be increased in the case of paddy crop whereas expenditure on tractor, HYV seeds, chemical fertilizers may be decreased.

Groundnut

From table 4, it is observed that the ratios of MVP and MC of bullock-labour, human-labour, HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods are greater than unity. This indicates the under utilization of these input variables. The ratio of expenditure on tractor is less than unity, indicates over utilization of expenditure on tractor. Further, it is noticed that the expenditure on tractor was marginally under utilized and the use of bullock labour, human-labour, HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods are insufficient. Hence, the pattern of resource use of Muttukur mandal needs some modification for groundnut, particularly, in the application of bullock-labour, human-labour, HYV seeds, chemical fertilizers, manures and pesticides

and other plant protection methods. These variables may be increased and expenditure on tractor may be reduced for better output.

Pellakur Mandal

The calculated ratios of MVP and MC pertaining to Pellakur mandal are given in table 5.

Table 5: Marginal Value Products of Pellakur Mandal

Inputs	Paddy			Groundnut		
	MVP	MC	Ratio	MVP	MC	Ratio
Bullock-labour	-	1.000	-	0.84904	1.000	0.84904
Expenditure on Tractor	-0.16276	1.000	-0.16276	0.16891	1.000	0.16891
Human-labour	1.78429	1.000	1.78429	0.26694	1.000	0.26694
HYV Seeds	9.41395	1.000	9.41395	0.14138	1.000	0.14138
Chemical Fertilizers	10.06811	1.000	10.06811	13.56883	1.000	13.56883
Manures	2.73430	1.000	2.73430	7.79451	1.000	7.79451
Pesticide and other Plant Protection Expenditure	1.77911	1.000	1.77911	2.49774	1.000	2.49774

Paddy

In the case of paddy crop, it is found that the ratio of human-labour, HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods are greater than unity, indicating under utilization of these input variables. The ratios of MVP and MC of expenditure on tractor is less than unity and it indicates the over utilization of expenditure on tractor. Further, we found that the use of human-labour, HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods are deficient. Therefore, the pattern of resource use in Pellakur mandal needs some modification for paddy, particularly, the application of human-labour, HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods may be increased where as expenditure on tractor may be decreased.

Groundnut

From table 5, it is noticed that the ratios of MVP and MC of chemical fertilizers, manures and pesticides and other plant protection methods are greater than unity and there indicating under utilization of the input variables. The ratios of bullock-labour, expenditure on tractor, human-labour, HYV seeds are less than unity and this indicates over utilization of bullock-labour, expenditure on tractor, human-labour, HYV seeds.

Further, it is also observed that they are marginally utilized. The use of chemical fertilizer, manures and pesticides and other plant protection methods are deficient.

Therefore, the pattern of resource use in Pellakur mandal needs some modification for groundnut, particularly, the application of chemical fertilizers, manures and pesticides and other plant protection methods may be increased where as bullock-labour, expenditure on tractor and HYV seeds may be decreased.

But Eswar Prasad, Sriram Murthy, Satyanarayana, Chennarayudu and Lalith Achoth[5] studied resource use efficiency of various resources in cotton farms in Guntur district.

The results of their production function and analysis clearly indicate the need for resources adjustment in farms of both LPS – 141 (recent variety) and MCV – 5 (Traditional Variety), in order to raise the productivity levels. The results of Sankhayan and Sirohi[7] suggested that at the present level of technology, the farm resources within each crop optimally or near optimally allocated.

CONCLUSIONS

Kaligiri Mandal

Paddy

The regression co-efficients of the seven variables except bullock-labour are positive. The regression co-efficient of human-labour (0.4161) is highest and it is followed by pesticides and other plant protection methods, HYV seeds, chemical fertilizers and manures. The positive co-efficient of human-labour indicates that, keeping all other variables constant at their respective geometric mean level, with the increase of one rupee in human-labour the amount of gross output including by-products of paddy would tend to increase by Rs. 0.42. Similarly in the case of HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods it would increase by Rs. 0.16, Rs. 0.09, Rs. 0.04 and Rs. 0.30 respectively. The co-efficients of human-labour, HYV seeds and pesticides and other plant protection methods are significant at 5 percent probability level. The co-efficient of bullock-labour is negative. From the above discussion it is observed that the effect of technological variables on paddy production in Kaligiri mandal is more. The constant returns to scale was observed in case of paddy crop in Kaligiri mandal. It is also found that, to get more yield of paddy, the pattern of resource use in Kaligiri mandal needs some modification, particularly, in the application of technological factors – HYV seeds, chemical fertilizers and pesticides and other plant protection methods may be increased where as expenditure on tractor may be decreased.

Groundnut

The regression co-efficient of all the input variables are positive. The co-efficient of pesticides and other plant protection methods (0.3308) is highest and it is followed by HYV seeds, human-labour, manures and chemical fertilizers. The positive co-efficient of pesticides and other plant protection methods indicates that with the increase of one rupee in pesticides and other plant protection methods, the amount of gross output including by-products of groundnut would tend to increase by Rs. 0.33. Similarly, in the case of human-labour, HYV seeds, chemical fertilizers and manures it would be Rs. 0.16, Rs. 0.19, Rs. 0.14 and Rs. 0.14 respectively. The regression co-efficients of human-labour, chemical fertilizers and manures or statistically significant at 5 percent probability level. It is observed that the effect of pesticides and other plant protection methods, human-labour, HYV seeds on groundnut production is more. It is found that there is constant returns to scale in groundnut farms of Kaligiri mandal. Further, it is also noticed, to get more yield of groundnut, the pattern of resource use in Kaligiri mandal needs some modification, particularly in the application of technological inputs – pesticides and other plant protection methods, chemical fertilizers and HYV seeds may be increased and expenditure on tractor may be decreased.

Muttukur Mandal

Paddy

The regression co-efficients of expenditure on tractor, chemical fertilizers and manures are negative. The negative co-efficients reveals that an increase of one rupee in each of these variables will decrease the output by Rs. 0.02, Rs. 0.02 and Rs. 0.03 respectively. The regression co-efficients of bullock-labour, human-labour, HYV seeds and pesticides and other plant protection methods are positive. The co-efficient of human-labour (0.8175) is highest and it is followed by pesticides and other plant protection methods, HYV seeds and bullock-labour. The positive co-efficients reveals that for every one rupee increase in these variables will raise the output by Rs. 0.82, Rs. 0.02 and Rs. 0.33 respectively. A constant returns to scale may be observed in paddy farms of Muttukur mandal. Further, it is also found that, to get more paddy output, the pattern of resource use in Muttukur mandal needs some modification, particularly, in application of

technological factors – pesticides and other plant protection methods may be increased whereas application of expenditure on tractor, HYV seeds and chemical fertilizers may be decreased.

Groundnut

The regression co-efficient of all the input variables are positive. The co-efficients of bullock-labour (0.3589) is highest and it is followed by chemical fertilizers, human-labour, HYV seeds, manures, pesticides and other plant protection methods and expenditure on tractor. The positive regression co-efficient of bullock-labour indicates that, for every one rupee increase in bullock-labour, the amount of gross output including by-products of groundnut would tend to increase by Rs. 0.36. Similarly, in the case of expenditure on tractor, human-labour, HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods it would be Rs.0.03, Rs. 0.18, Rs. 0.12, Rs. 0.19, Rs. 0.09 and Rs. 0.07 respectively. The regression co-efficients of bullock-labour, expenditure on tractor, human-labour, HYV seeds and chemical fertilizers are statistically significant at 5 percent probability level. From the above observations, one can say that the both traditional and technological factors are having equal importance in groundnut production. A constant returns to scale is noticed in groundnut farms of Muttukur mandal, was noticed. To get more yield of groundnut, the pattern of resource use in Muttukur mandal needs some modification, particularly, application of technological factors – chemical fertilizers, HYV seeds and pesticides and other plant protection methods may be increased where as expenditure on tractor may be decreased.

Pellakur Mandal

Paddy

The regression co-efficients of both bullock-labour and expenditure on tractor are negative but they are very low. The regression co-efficients of human-labour, HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods are positive. The co-efficient of chemical fertilizers (0.4850) is highest and it is followed by HYV seeds, human-labour, manures and pesticides and other plant protection methods. The positive co-efficient of chemical fertilizers indicates that with the increase of one rupee in chemical fertilizers, the amount of gross output of paddy would tend to increase by Rs. 0.48. Similarly, in the case of human-labour, HYV seeds, manures and pesticides and other plant protection methods it would be Rs. 0.10, Rs. 0.29, Rs. 0.10 and Rs. 0.06 respectively. The co-efficients of bullock-labour, HYV seeds, chemical fertilizers, manures and pesticides and other plant protection methods are statistically significant at 5 percent probability level. Hence, one can say that the both traditional and technological factors are having equal importance in paddy production. A constant returns to scale was operating in paddy farms in Pellakur mandal. It is also found that, to get more yield of paddy, the pattern of resource use in Pellakur mandal needs some modification, particularly, modifications in technological factors – HYV seeds, chemical fertilizers and other plant protection methods may be increased and expenditure on tractor may be decreased.

Groundnut

The regression co-efficient of all input variables are positive. The co-efficients of chemical fertilizers and manures are statistically significant at 5 percent probability level. The co-efficient of chemical fertilizers (0.5905) is highest and it is followed by manures, pesticides and other plant protection methods, bullock-labour, human-labour, HYV seeds and expenditure on tractor.

The positive co-efficient of chemical fertilizers indicates that for every one rupee increase in each of these variables, chemical fertilizers, bullock-labour, expenditure on tractor, human-labour, HYV seeds, manures and pesticides

and other plant protection methods will increase the output by Rs. 0.59, Rs. 0.02, Rs. 0.01, Rs. 0.01, Rs. 0.27 and Rs. 0.28 respectively. The constant returns to scale are operating in groundnut of Pellakur mandal.

It is also found that, to get more yield of groundnut, the pattern of resource use in Pellakur mandal needs some modifications, particularly, in application of technological factors – chemical fertilizers and pesticides and other plant protection methods may be increased and expenditure on tractor and HYV seeds may be decreased to obtain better output.

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